

REMARKS

In response to the Official Action of October 3, 2003, Applicants have hereby canceled Claims 46-61, in order to advance prosecution of the present application. However, Applicants respectfully submit that remaining Claims 62, 64-74, 76 and 78-87 are patentable under 35 USC §103(a) over the combination of five or six references that were cited in the Official Action, for the reasons that now will be described. Accordingly, Applicants respectfully request allowance of Claims 62, 64-74, 76 and 78-87, and the withdrawn claims (Claims 1-45, 63, 75, 77 and 88-120) that depend therefrom, for the reasons that will be described below.

Claims 62 and 64-73 Are Patentable

Independent Claim 62 recites:

62. A light emitting diode comprising:
a substrate having first and second opposing faces, the first face having smaller surface area than the second face;
a diode region on the second face;
a first ohmic layer on the first face opposite the diode region;
an adhesion layer on the first ohmic layer opposite the substrate;
a first barrier layer on the adhesion layer opposite the first ohmic layer;
a first bonding layer on the first barrier layer opposite the adhesion layer;
a second ohmic layer on the diode region opposite the substrate;
a reflector layer on the second ohmic layer, opposite the diode region;
a second barrier layer on the reflector layer opposite the second ohmic layer;
and
a second bonding layer on the second barrier layer opposite the reflector layer.

Applicants wish to note that, in some embodiments, Claim 62 may be embodied, for example, in Figure 17A of the present application, including substrate **1310**, diode region **1320**, first ohmic layer **1732**, adhesion layer **1734**, first barrier layer **1736**, first bonding layer **1738**, second ohmic layer **1742**, reflector layer **1744**, second barrier layer **1746** and second bonding layer **1748**.

The present application describes, at Page 27, line 3-Page 29, line 21 various potential advantages that may be obtained by embodiments of Figures 17A. For example, Page 27, line 29-Page 28, line 11 state:

In sharp contrast, embodiments of the invention as illustrated in Figure 17A can employ an ATON geometry and/or other geometries that include a reduced area first face **1310a** compared to the second face **1310b**, that is flip-chip mounted to a

mounting support **210**, such that the diode region **1320** is adjacent the mounting support **210**, and the substrate **1310** is remote from the mounting support **210**.

Moreover, as also shown in Figure 17A, additional efficiency may be obtained by using p-contact structures **1740** that include a p-ohmic region **1742**, a reflector **1744**, a barrier region **1746** and/or a bonding region **1748**. In some embodiments, the p-ohmic region **1742** may comprise a p-ohmic metal, such as nickel/gold, nickel oxide/gold, nickel oxide/platinum, titanium and/or titanium/gold, between about 10 Å and about 100 Å thick. In some embodiments, the p-ohmic region **1742** can comprise a continuous or non-continuous p-ohmic metal, with an area coverage of between about 10% and about 100%, and a thickness of between about 2Å and about 100Å. For non-continuous p-ohmic metals, the conductivity of the underlying diode's layers may be matched to the area coverage, to enhance the uniformity of current injection into the diode-active region.

Applicants respectfully submit that the combination of at least four layers on the first face **1310** of the substrate and at least four layers on the diode region **1320**, as recited in Claim 62, would not be obvious from the cited references. In particular, Carter-Coman et al. describes a single layer ohmic contact **33** on the substrate. Krames et al. Figures 10 and 11 recite single layer contacts **9** for the diode. Applicants' prior art Figure 13 describes a single layer contact **1330** on one face of the LED. Lee Figure 1 describes a laser diode that is bonded to silicon or ceramic submounts using a seven-layer structure at one face of the diode. Finally, Mensz teaches top electrical contacts for LEDs that include a reflector/ohmic layer.

Applicants respectfully submit that it would not be obvious to selectively pick and choose various layers from these references. Moreover, the combination of all these references does not appear to describe or suggest the recitations of Claim 62 quoted above. Finally, there does not appear to be any motivation in any of the cited references to combine these references to provide the potential advantages which are described, for example, in the above-quoted sections of the application.

In view of the above, Claim 62 is patentable. Dependent Claims 64-73 also are patentable as per the patentability of Claim 62 from which they depend. Moreover, dependent Claim 65 is independently patentable, because none of the references describe or suggest that reflective materials should be used in the top and bottom contacts of an ATON-type LED. Also, dependent Claim 73 is independently patentable because, as noted in connection with Figure 17B in the present application at Page 29, lines 22-30, potential advantages may be provided with n-contact structures that include a central portion and at least one finger, and none of the cited references describe this structure.

Claim 74 Is Patentable

Claim 74 is analogous to Claim 62, except that the layers are connoted by their compositions rather than their function. Claim 74 is patentable for the same reasons that were described above in connection with Claim 62. This analysis will not be repeated for the sake of brevity.

Claims 76 and 78-86 Are Patentable

Claim 76 recites:

76. A light emitting diode comprising:
a substrate having first and second opposing faces, the first face having smaller surface area than the second face;
a diode region on the second face;
a first adhesion layer on the first face opposite the diode region;
a first barrier layer on the first adhesion layer opposite the substrate;
a first bonding layer on the first barrier layer opposite the first adhesion layer;
an ohmic layer on the diode region opposite the substrate;
a reflector layer on the ohmic layer opposite the diode region;
a second adhesion layer on the reflector layer opposite the ohmic layer;
a second barrier layer on the second adhesion layer opposite the reflector layer; and
a second bonding layer on the second barrier layer opposite the second adhesion layer.

Claim 76 may be embodied, for example, in Figure 18 of the present application including substrate 1310, diode region 1320, first adhesion layer 1812, first barrier layer 1814, first bonding layer 1816, ohmic layer 1830, reflector layer 1828, second adhesion layer 1826, second barrier layer 1824, and second bonding layer 1822.

Applicants again respectfully submit that these contact structures including a bottom contact that includes at least three layers and a top contact that includes at least five layers, would not be obvious for at least the reasons that were described above in connection with Claim 62. This analysis will not be repeated for the sake of brevity. Moreover, Page 30, line 20-Page 31, line 18 of the present application describe many potential advantages of configurations of Figure 18. For example, as noted at Page 30, lines 20-28:

Figure 18 is a cross-sectional view of light emitting diodes according to still other embodiments of the present invention. More specifically, Figure 18 illustrates a conventional ATON LED that includes a reflector on the diode region thereof. It has been found, unexpectedly, according to embodiments of the invention, that by adding a reflector to the diode region of a conventional right-side-up ATON and/or other LED, an increase in brightness of about 10% or more may be obtained compared to a

conventional ATON and/or other LED that does not have a reflector on the diode region at the top surface thereof. Thus, by at least partially blocking the top surface with a reflector, increased light emission actually may be obtained.

For at least these reasons, Claim 76 is patentable over the cited references.

Dependent Claims 78-86 are patentable at least per the patentability of Claim 76 from which they depend.

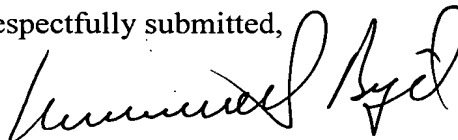
Claim 87 Is Patentable

Finally, Claim 87 is analogous to Claim 76, except that it recites compositions of the various layers of, for example, Figure 18, rather than the function of these layers. Claim 87 is patentable for at least analogous reasons to those discussed with reference to Claim 76. This analysis will not be repeated for the sake of brevity.

Conclusion

Applicants thank the Examiner for the thorough examination. In order to expedite the prosecution, many of the claims have now been canceled. However, Applicants respectfully submit that the remaining claims and the withdrawn claims that depend therefrom are patentable for at least the reasons described above. Accordingly, Applicants respectfully request withdrawal of the outstanding rejections and allowance of the present application.

Respectfully submitted,




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